Comments on Roadmap to Commercialize Microgrids in California

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As the California Energy Commission, California Public Utilities Commission, and California Independent System Operator undertake an effort to develop a roadmap to commercialize microgrids in the state, please consider the following discussion of drivers and challenges for microgrids. The following was originally published on October 19, 2015 for the Energy Institute at Haas blog and can be found at https://energyathaas.wordpress.com/2015/10/19/could-microgrids-be-big-in-the-us/.

Could Microgrids Be Big in the US?

Posted on October 19, 2015 by Andrew Campbell

Three years ago this week, Hurricane Sandy began forming in the Caribbean Sea. It went on to wallop several Caribbean islands and the Eastern Seaboard. In the US the storm caused an estimated $75 billion in damage. The electricity system was hit especially hard. Over 8 million homes lost power.

Policymakers on the East Coast don't want to experience Sandy-style outages again. That's led them to microgrids, in turn popularizing the concept around the country.

So, what exactly is the benefit of a microgrid?

To answer that, first we have to recognize that the electric distribution system is fragile. Harmless seeming trees, squirrels and Mylar balloons routinely cause widespread outages. Most grid incidents don't just affect downstream customers, but also cause a ripple effect, knocking out upstream and adjacent circuits.

Enemies of the power grid gather

Other networks we deal with daily are more robust. If a tree falls on a road, traffic re-routes to adjacent roads. Global internet traffic is constantly rerouting around congestion and outages to get to its destination. Even a local internet problem can be mitigated by jumping on a cellular network or your neighbor's wi-fi.

A microgrid, then, is intended to bring more resiliency to the electric grid. It ties together local distribution equipment and generators, and keeps them up and serving demand, even if the surrounding grid is down.

For example, San Diego Gas & Electric is developing a microgrid in Borrego Springs, California. The remote community is served by only one transmission line that runs through a fire-prone area. The microgrid, which combines energy storage and solar photovoltaics, is intended to keep the area energized when the transmission line goes down.

New Jersey's public transit operator, NJ TRANSIT, is also investigating the feasibility of a microgrid to keep its rail system operating even when power outages hit certain parts of the grid.

The University of California, San Diego's campus has developed a slightly different flavor of microgrid, one that goes beyond resiliency to market response. Consumption and generation on the campus can be optimized jointly in response to electricity prices. For example, the aggregate consumption can be reduced in response to high wholesale energy prices, or peaks can be shaved to avoid demand charges.

Additional companies and policymakers are considering whether investments into microgrids make sense. How should they assess the opportunity?

Reviewing the costs and benefits is a good place to start.

Costs include deploying distributed energy resources, installing advanced grid equipment such as automatic switches, and installing a microgrid controller to keep all the parts working harmoniously.

Distributed energy resources such as rooftop solar and energy storage face challenging economics, especially as regulators continue to reform retail pricing . Of course, that could change over time.

Meanwhile advanced grid equipment, like switches that automatically reconfigure the grid to avoid outages, are becoming more common and accepted by the industry.

Still, fundamental technological breakthroughs are also needed. The microgrid controller is a substantial challenge as explained in this Sandia National Lab report. The microgrid needs to recreate the functions of the bulk power grid in a highly local area. For example, microgrid supply and demand need to be kept in balance in real time. That's tough on the bulk grid, but even more challenging on a small scale where there's no room for error. Any entity pursuing a microgrid today will be taking on a research and development effort on these controllers.

On the benefits side, microgrids potentially offer improved reliability, lower costs and greater integration of distributed renewable energy.

I expect reliability is the most important benefit. Focusing on ways to improve electrical reliability in the US makes sense, especially given our poor reliability relative to other industrialized nations.

In a world full of microgrids, few customers would experience outages. Grid problems would be quickly isolated and distributed energy resources would supply customers who are cut off from the bulk grid.

However, utilities have many alternative tools available to enhance reliability. Burying overhead lines, building redundant connections and investing in automated switches are all tried-and-true solutions.

An honest evaluation of microgrids needs to consider these existing alternatives.

Microgrids could also lower costs in some instances. For example, a microgrid could manage peak demand served by a particular substation in order to avoid or delay an upgrade. Once again, alternatives need to be evaluated. The cost of upgrading the substation could be more or less than the cost of setting up and running the microgrid.

Using a microgrid to help integrate distributed renewable energy is another benefit supporters point to. The idea is that the intermittent generation from, say, distributed solar, could be matched to energy storage and consumer demand to keep a circuit from becoming overloaded. This approach would allow utilities to accommodate new distributed solar installations on a crowded circuit, instead of prohibiting them, as recently happened in Hawai'i triggering widespread protests.

Even faced with multiple hurdles and cheaper alternatives, investments in microgrids could still make sense.

Government R&D funders need to consider whether microgrids should be prioritized above other R&D objectives. I suspect that microgrids R&D would make the cut in the US given our sorry electrical reliability. We need to do something different on the grid. Microgrids could be part of the answer.

For private companies, the case is tougher. A company would need to believe that it can capture the R&D spillovers by patenting new technologies that are developed and selling them to others. That's a risky proposition given the immaturity of microgrid technology.

In the near-term, the dominant model is government and private sector partnerships. Companies invest an amount that makes sense given their likely private gains, and government R&D pays the rest. That approach makes sense.

Of course there's also the "cool" factor.

The microgrid of my childhood

Growing up in Houston, I remember getting excited as hurricanes approached. I enjoyed pulling out the candles and flashlights to prepare for the inevitable power outage. Perhaps the children of 2030 will get just as excited about the activation of their microgrid to get them through the storm.